

**Elliott Bay, Seattle, Washington  
Alaskan Way Seawall  
Flood and Coastal Storm Damage Reduction Project**

**Formulation and Screening of  
Design Concepts and Alternatives**

**1. PURPOSE.** The purpose of this document is to describe the design concepts and alternatives that have thus far been considered for replacement of the Alaskan Way Seawall, and to describe the screening process utilized to determine the alternatives that will be carried forward by the U.S. Army Corps of Engineers (Corps) and the City of Seattle for further evaluation in an Environmental Impact Statement (EIS) that will be prepared in support of the Alaskan Way Seawall project feasibility study. It has been determined that an EIS will be necessary in support of this study. A scoping meeting for the federal EIS will be held, during which further input from the public will be taken to determine if additional alternative plans should be evaluated in the EIS.

**2. BACKGROUND.** The current Alaskan Way Seawall feasibility study was initiated in August 2004 as a study cost sharing partnership between the city of Seattle and the Corps. The Alaskan Way Seawall feasibility study is closely related to the proposed replacement of the State Route (SR) 99 Alaskan Way Viaduct, which runs parallel to a significant portion of the Seawall. Key Alaskan Way Seawall-related planning activities that pertain specifically to the screening of design concepts for the Seawall and the formulation and screening of alternatives are summarized below:

- **February 28, 2001** – The Nisqually earthquake damaged the Alaskan Way Viaduct (Viaduct). Due to the seismic vulnerability of the Viaduct, the Washington State Department of Transportation (WSDOT) led a Phase 1 screening process to develop and screen a range of concepts for retrofitting or replacing the Viaduct and improving areas located in the Viaduct Corridor. The Viaduct Corridor includes State Route (SR) 99 from Spokane Street on the south to Ward Street north of the Battery Street Tunnel. Specifically, the Viaduct Corridor includes portions of East Marginal Way; an at-grade section of SR 99 from Spokane Street to South Holgate Street; the Alaskan Way Viaduct structure; the Battery Street Tunnel; a section north of the Battery Street Tunnel to Ward Street; the Alaskan Way surface street, and the Alaskan Way Seawall.
- **August 2001** – WSDOT completed their Phase 1 screening process of design concepts for the Viaduct Corridor. The Phase 1 screening process did not specifically address concepts for retrofitting or replacing the Alaskan Way Seawall.
- **August 2001** – WSDOT began a Phase 2 Viaduct Corridor screening process, involving further project definition and refinement. The Federal Highway Administration (FHWA) and the City of Seattle became co-leads with WSDOT for the Viaduct Corridor

project. At this time, additional information was collected regarding the condition of the Alaskan Way Seawall. The information showed that the Seawall was also seismically vulnerable and in a state of disrepair. The information also showed that the structural integrity of the Viaduct is dependent on the Seawall. As a result, the project purpose and need statement was revised to include the Seawall, and the project screening criteria were revised to support the new purpose and need statement. Additional design concepts were developed and evaluated as part of the Phase 2 screening process to consider both the Viaduct and the Seawall. These concepts were suggested in meetings involving WSDOT, the City of Seattle, FHWA, neighborhood groups, business interests, organizations and agencies, and the public.

- **March 2002.** Seawall design concepts were developed and screened separately in the overall Phase 2 Viaduct Corridor screening process described above. The results of that process are documented in a March 2002 report entitled *SR 99: Alaskan Way Viaduct and Seawall Project Screening of Seawall Concepts*. The report was prepared by Berger/Abam Engineers, and submitted to WSDOT/FHWA/City of Seattle by Parsons Brinckerhoff Quade & Douglas, Inc.
- **June 2003.** Conceptual design options were re-examined to identify additional design options that might be more financially feasible to implement. To broaden the range of options that could be considered, the screening criteria were revised and the Seawall design concepts from Phase 2 were re-screened by WSDOT/ FHWA/City of Seattle. Information related to screening for the Seawall options is contained in a June 2003 report entitled *SR 99 Alaskan Way Viaduct and Seawall Project Revised Screening of Seawall Concepts*. The report was prepared by Parametrix, Inc. and submitted to WSDOT/FHWA/City of Seattle by Parsons Brinckerhoff Quade & Douglas, Inc.
- **March 2004.** Draft Environmental Impact Statement for SR 99 Alaskan Way Viaduct and Seawall Replacement project is released by WSDOT, FHWA, and City of Seattle.
- **August 2004.** The congressionally authorized Alaskan Way Seawall project feasibility study was initiated by the Corps and City of Seattle. The feasibility study is a cost sharing partnership between the Corps and the City. The study is being conducted concurrent with, but independent of, the WSDOT/FHWA/City of Seattle Viaduct Corridor study.
- **September 2005.** The Corps had a review conducted of the March 2004 Alaskan Way Viaduct and Seawall Replacement project DEIS and supporting technical documents, to identify “gaps” – or potential areas for additional study – that may be needed to support the Corps’ environmental analysis under the National Environmental Policy Act (NEPA). The report, entitled *Gap Analysis for Elliott Bay Seawall Feasibility Study: Seattle, Washington*, was prepared for the Corps by Jones & Stokes.

### 3. DEVELOPMENT AND SCREENING OF SEAWALL DESIGN CONCEPTS.

Plan formulation is an iterative process of identifying concepts and measures to address identified problems and opportunities, evaluating concepts and measures and formulating alternative plans, evaluation and screening of alternative plans against evaluation criteria, and the ultimate selection and adoption of a recommended plan for implementation. As part of the Corps/City of Seattle feasibility study, previous development and screening of alternative plans is being continuously reviewed to ensure that all practicable measures and alternative plans are carried forward for evaluation against the “no action” alternative as part of the National Environmental Policy Act (NEPA) process. In considering the screening criteria, design concepts and alternative plans, the reader should bear in mind that the project is a major rehabilitation of an existing structure. The rehabilitation might involve replacing, retrofitting, or a combination of measures. The Alaskan Way Seawall is an aging and deteriorating public infrastructure that is co-located with existing land and water uses, utilities and transportation features that are dependent upon and thus constrain the selected alternative plan for major rehabilitation.

**3.1. March 2002 Initial Seawall Screening Criteria and Design Concepts.** Design and screening of Seawall concepts was initiated in August 2001 by WSDOT/ FHWA/City of Seattle as part of the Phase 2 Viaduct Corridor screening process (see Paragraph 2 above). The results of that process are documented in a March 2002 report entitled *SR 99: Alaskan Way Viaduct and Seawall Project – Screening of Seawall Concepts*. It was concluded that the Seawall was seismically vulnerable and in a state of disrepair. In addition, the structural integrity of the Viaduct was determined to be dependent on the structural integrity of the Seawall. Results of the initial screening are summarized below.

**a. Screening Criteria.** Screening criteria were developed based upon the project purpose and need statement by WSDOT and the City of Seattle dated November 2, 2001. The project purpose stated in the 2001 statement was “to maintain or improve mobility for people and goods along the existing SR 99 corridor and to improve safety, including the ability of the transportation facilities and the Seawall to resist earthquakes”. Alternative Seawall concepts were evaluated and compared to the same screening criteria as those for the Viaduct project alternatives. **The screening criteria are expressed as a series of nine goals, with meeting the first two goals – seismic safety and transportation functions – a requirement for any alternative to be advanced.** Alternatives that did not meet these mandatory criteria were dropped from consideration without further evaluation. Accordingly, the initial screening criteria used to evaluate Seawall alternatives presented as Appendix C of the above referenced March 2002 report were as follows (see enclosure 1)<sup>1</sup>:

- Goal 1: An alternative must provide a facility that meets current seismic design standards.
- Goal 2: An alternative must maintain or improve the transportation functions of the Alaskan Way Viaduct corridor.
- Goal 3: All alternatives should improve traffic safety.

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<sup>1</sup> City of Seattle and Washington State Department of Transportation. *SR 99: Alaskan Way Viaduct Project – Alternatives Screening Criteria*. January 2002. Prepared by Parsons Brinckerhoff Quade & Douglas, Inc.

- Goal 4: An alternative should maintain or improve transportation system linkages regionally and should allow for future linkages.
- Goal 5: An alternative should minimize adverse impacts during construction.
- Goal 6: An alternative should minimize environmental impacts during and after construction.
- Goal 7: An alternative should minimize social and cultural impacts during and after construction.
- Goal 8: An alternative should support land use and shoreline plans and policies pertaining to existing and future development of the downtown Seattle waterfront.
- Goal 9: An alternative should support improved habitat for fish and wildlife along the Alaskan Way Seawall.

**b. Seawall Alternatives.** The above referenced March 2002 report considered both Seawall replacement options and Seawall retrofit options. Screening of Seawall replacement option and retrofit option concepts at this stage of project formulation focused specifically on ensuring that the structural integrity of the Viaduct is not compromised due to structural failure of the Seawall resulting from an earthquake. The concepts were developed using estimates of the loads that are anticipated for an earthquake having a 10 percent probability of being exceeded in a 50-year period. The range of conceptual Seawall replacement and retrofit options that were considered is shown in Appendix B of the March 2002 report (see Enclosure 2). There were three Seawall replacement options, representing 36 variations, or sub-options. In addition, there were three Seawall retrofit options, representing 16 variations, or sub-options. The replacement and retrofit options are summarized below.

- Seawall Replacement Options – Replacement options entirely replace the existing Seawall, providing structural capacity to carry all vertical, as well as lateral, loads due to earthquakes and the associated liquefaction of the retained soils. A total of 36 variations (“sub-options”) of three basic Seawall replacement structure types were initially considered:
  - Option A1 – Wharf with Fill Removed (Sixteen variations (sub-options) of this option are listed on Enclosure 2)
  - Option A2 – Wharf with Intertidal Beach (Eight variations (sub-options) of this option are listed on Enclosure 2)
  - Option A3 – Vertical Face Wall with Structural Frame (Twelve variations (sub-options) of this option are listed on Enclosure 2)
- Seawall Retrofit Options – designed to address specific deficient features of the existing Seawall. Generally, these options maintain the existing configuration of the Seawall, but add lateral capacity to withstand increased earth pressures during an earthquake. A total of 16 variations (“sub-options”) of three basic Seawall retrofit structure types were initially considered:

- Option B1 – Face Wall Only (Three variations of this option, or sub-options, are listed on Enclosure 2)
- Option B2 – Anchored Wall (Nine variations of this option, or sub-options, are listed on Enclosure 2)
- Option B3 – Buttress Fill (One variation of this option, or sub-option, is listed on Enclosure 2)

c. **Screening Results.** It was determined that some of the sub-options were either impractical or had undesirable constructability issues associated with them, while offering no benefit over the other options and sub-options considered. Those concepts that failed to meet the screening criteria were eliminated from further consideration. In general, the concepts that used uncommon construction techniques, required cofferdams to isolate the construction from the water, and/or appeared to have more obvious impacts to the businesses located along the waterfront were eliminated. **Three concepts were recommended to be carried forward to the EIS: seawall replacement Option A1 – wharf with fill removed, seawall replacement Option A3 – vertical faced wall with structural frame, and seawall retrofit Option B1 – face wall only.** Screening results for all options considered in the March 2002 report are summarized below.

- Seawall Replacement Option A1 – Wharf with Fill Removed. The wharf with fill removed seawall replacement option was recommended to be carried forward to the EIS for the following reasons:
  - Construction of the seawall would be along the east side of Alaskan Way and could be accomplished while maintaining traffic on the west side.
  - Places the new seawall construction behind the existing relieving platform, minimizing risk of weakening the existing structure during construction.
  - Removes the existing relieving platform and potentially liquefiable soil that would otherwise need to be retained or improved.
  - Open water is created below the wharf, adding potential for marine habitat.
  - Places the primary lateral load carrying seawall structural element at the bulkhead where the height of soil to be retained is a little less, lowering the lateral load design requirements.
  - The deck structure uses typical pier construction, common throughout the Pacific Northwest. Precast elements are manufactured offsite and installed quickly.
- Seawall Replacement Option A2 – Wharf with Intertidal Beach. The wharf with intertidal beach seawall replacement option was not recommended to be carried forward to the EIS for the following reasons:
  - The value of the intertidal beach is marginal, at best, without a source of light.
  - The scour protection required to protect the beach would probably consist of riprap material that are not conducive to the creation of the desired beach characteristics.
  - If slope protection is not provided, constant maintenance of the beach slopes is likely to be required.

- The structural complications and the additional construction time and public disruption associated with this option do not seem warranted given the marginal benefits provided.
- Seawall Replacement Option A3 – Vertical Face Wall with Structural Frame. The vertical faced wall with structural frame seawall replacement option was recommended to be carried forward to the EIS for the following reasons:
  - This option uses a moment resistant frame to provide redundancy and allow less required embedment of shafts and slurry wall into the competent soils, which may save time and expense. The bulkhead is not a full wall, but does resist partial lateral earth pressure. A full engineering analysis is required to determine if these advantages can be realized.
  - This option does not require removal of much of the existing fill, which may be contaminated.
  - This option also provides potential to perform all work in isolation from Elliott Bay, except for the removal of portions of the existing seawall. Such removal can be quickly accomplished within anticipated fish windows after the new seawall is completed.
- Seawall Retrofit Option B1 – Face Wall Only. The face wall only seawall retrofit option (with construction inboard of the existing wharf wall) was recommended to be carried forward to the EIS for the following reasons:
  - The drilled shaft sub-options would provide a single line of deep wall to resist the lateral earth pressure from seismically liquefied soil.
  - Installation of retrofit wall behind (inboard) of the existing wall would avoid having to remove existing heavy riprap along the face of the wall, avoid disturbing potentially contaminated bottom sediments, avoid need for a sheet pile cofferdam to isolate construction from Elliott Bay, as well as avoid need for temporary structural modifications to the existing piers.
  - Only minimal space along the waterfront is required, minimizing utility disturbance and relocations.
  - A substantial portion of the construction can be located behind the existing relieving platform, minimizing the disruption to businesses along the waterfront.
  - Proven construction methods and elements are used.
- Seawall Retrofit Option B2 – Anchored Wall. The anchored wall seawall retrofit option was not recommended to be carried forward to the EIS for the following reasons:
  - Construction would take longer than retrofit option B1 above and offers few, if any, apparent advantages.
  - The tieback for the anchored wall is likely to be an obstruction to utilities and susceptible to increased stress from settlement of soil.

- Seawall Retrofit Option B3 – Buttress Fill. The buttress fill seawall retrofit option was not recommended to be carried forward to the EIS for the following reasons:
  - Difficult construction around existing piers. Poses a significant risk of damaging the pier structures by creating additional loads on pilings, particularly batter piles.
  - Filling of slips would adversely affect waterfront businesses that use them.
  - Time consuming and difficult soil improvement in the tidal zone would be required to support the weight of buttress fill, with significant environmental impacts during construction.

**3.2. June 2003 Revised Screening of Seawall Concepts.** Conceptual engineering conducted after completion of the March 2002 screening process resulted in additional information on design options and their cost. In addition, in November 2002 voters rejected a tax plan referendum that would have provided some funding for the Alaskan Way Viaduct and Seawall project. To identify additional design options that might be less costly to implement, WSDOT and the City of Seattle re-examined conceptual design options. The screening criteria were revised, necessitating that all of the design concepts from the March 2002 report (see Paragraph 3.1 above) be re-screened with the new criteria. Results of the screening of Viaduct options is documented in a June 2003 report entitled *SR 99: Alaskan Way Viaduct & Seawall Replacement Project – Final Revised Screening of Seawall Concepts*. The report was prepared by Parametrix, Inc. and submitted to WSDOT/FHWA/City of Seattle by Parsons Brinckerhoff Quade & Douglas, Inc. Results of the revised screening are summarized below.

**a. Revised Screening Criteria.** The revised screening criteria are expressed as a series of ten goals (as opposed to nine goals from the March 2002 initial screening criteria). These criteria were approved by WSDOT, FHWA, City of Seattle, and participating agencies in the Resource Agency Leadership Forum<sup>2</sup>. The revised screening criteria are similar to the March 2002 screening criteria, and are as follows:

- Goal 1: An alternative must provide facilities that meet current seismic design standards.
- Goal 2: An alternative must maintain the current transportation functions of the Alaskan Way Viaduct Corridor.
- Goal 3: An alternative should not further degrade the operation of other major transportation facilities.
- Goal 4: An alternative should improve traffic safety.
- Goal 5: An alternative should maintain regional transportation linkages.
- Goal 6: An alternative should support bicycle and pedestrian accessibility and mobility.
- Goal 7: An alternative should be compatible with local, express, and high-capacity transit.
- Goal 8: An alternative should support land use and shoreline plans and policies pertaining to development of the downtown Seattle waterfront.

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<sup>2</sup> The Resource Agency Leadership Forum is comprised of regulatory agencies party to the Signatory Agency Committee (SAC) Agreement, and local agencies having jurisdiction in the project area.

- Goal 9: An alternative should support improved habitat for fish and wildlife along the Alaskan Way Seawall.
- Goal 10: An alternative should rely on proven construction methods, minimize construction duration, and promote effective traffic management during construction.

**b. Revised Seawall Alternatives.** All alternatives were screened using the ten goals above. Goals 1 and 2 had to be met for an alternative to be advanced. Alternatives that met goals 1 and 2 were evaluated against the remaining eight goals. Where similar options were available, the alternative that best met the screening criteria goals and project purpose and need was advanced for further consideration.

The six design alternatives considered in the March 2002 screening process, including sub-options that represent several structure types and construction methods (see Paragraph 3.1.b above), were re-evaluated as part of the revised screening process. In addition, one seawall replacement alternative was added for screening purposes, based on additional engineering design work completed between March 2002 and May 2003. This additional alternative is to replace the seawall with a drilled shaft wall with soil improvement behind the wall (Option A4).

The following options were considered as part of the June 2003 screening:

- Seawall Replacement Options. Seawall replacement options involve replacing the existing seawall by providing structural capacity to carry all vertical, as well as lateral, loads due to earthquakes and associated liquefaction.
  - Option A1 – Wharf with Fill Removed
  - Option A2 – Wharf with Intertidal Beach
  - Option A3 – Vertical Face Wall with Structural Frame
  - Option A4 – Drilled Shaft Wall with Soil Improvement (new option)
- Seawall Retrofit Options. Seawall retrofit options are designed to address specific deficient features of the existing walls. Generally, these maintain the existing configuration of the seawall, but add lateral capacity to withstand increased earth pressures during an earthquake. The retrofit options assume vertical capacity is maintained by the existing relieving platforms of the existing seawall.
  - Option B1 – Face Wall Only
  - Option B2 – Anchored Wall
  - Option B3 – Buttress Fill

**c. Revised Screening Results.** The seven alternative options were screened against the revised screening criteria listed in Paragraph 3.2.a above. **The revised screening process resulted in the recommendation to carry two seawall replacement alternatives forward for further analysis in the EIS. The two alternatives were Option A3 – vertical faced wall with structural frame, and Option A4 – drilled shaft wall with soil improvement.**

Note that these alternatives were developed without the detailed geotechnical knowledge required to fully assess their structural feasibility. They were developed using estimates of the loads that are anticipated for three levels of earthquake ground motion:

1. An expected earthquake, which has a 50 percent probability of being exceeded in 75 years (108-year return period). The seawall would remain “operational”.
2. A moderate earthquake, which has a 10 percent probability of being exceeded in 50 years (about a 500-year return period). This represents the City of Seattle’s current ground motion criteria for operational performance of important structures and facilities.
3. A rare earthquake, which has a 3 percent probability of being exceeded in 75 years (about a 2,500-year return period). The seawall would remain “life-safe”.

Screening results for the seven seawall alternatives considered in the June 2003 report are summarized below.

- Seawall Replacement Option A1 – Wharf with Fill Removed. The wharf with fill removed seawall replacement option was not recommended to be carried forward to the EIS for the following reasons:
  - The project purpose and screening criteria can be better met with other seawall alternatives.
  - This alternative is technically less feasible than other options due to required extensive utility relocations, the reduction in available space for utility relocations, and inability to meet utility offset distances. Some utilities would be required to hang under the wharf structure and thus be exposed to corrosive marine air.
  - This alternative offers limited habitat improvement. It would not provide natural light, intertidal elevations would not be part of the intertidal zone, and scour protection for the slope consisting of riprap materials that are not conducive to the creation of the desired beach would be required. See September 2002 technical memorandum<sup>3</sup>.
- Seawall Replacement Option A2 – Wharf with Intertidal Beach. The wharf with intertidal beach seawall replacement option was not recommended to be carried forward to the EIS for the following reasons:
  - The project purpose and screening criteria can be better met with other seawall alternatives.
  - This alternative is technically less feasible than other options due to required extensive utility relocations, the reduction in available space for utility relocations, and inability to meet utility offset distances. Some utilities would be required to hang under the wharf structure and thus be exposed to corrosive marine air.
  - This alternative offers limited habitat improvement. It would not provide natural light, intertidal elevations would not be part of the intertidal zone, and scour protection for the slope consisting of riprap materials that are not conducive to the

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<sup>3</sup> City of Seattle and Washington State Department of Transportation, *Recommendation to Remove the Marginal Wharf from Seawall Options*. September 2002. Prepared by BERGER/ABAM Engineers, Inc.

creation of the desired beach would be required. See September 2002 technical memorandum<sup>4</sup>.

- Seawall Replacement Option A3 – Vertical Face Wall with Structural Frame. The vertical faced wall with structural frame seawall replacement option was recommended to be carried forward to the EIS for the following reasons:
  - This alternative provides a seawall structure that can resist both vertical and lateral loads.
  - A substantial portion of the construction can be located behind the existing relieving platform, minimizing disruption to businesses along the waterfront.
  - This alternative does not require the removal of all the existing and potentially contaminated fill material.
  - The new seawall can be constructed behind the existing wall, allowing the work to be isolated from Elliott Bay.
  - The Alaskan Way Viaduct may be able to be supported on the bulkhead.
  - This alternative uses mostly proven construction methods and elements.
- Seawall Replacement Option A4 – Drilled Shaft Wall with Soil Improvement. The drilled shaft wall with soil improvement seawall replacement option was recommended to be carried forward to the EIS for the following reasons:
  - This alternative provides a seawall structure that can resist both vertical and lateral loads.
  - This alternative does not require the removal of all the existing and potentially contaminated fill material.
  - The new seawall can be constructed mostly behind the existing wall, allowing the work to be isolated from Elliott Bay.
  - This alternative uses mostly proven construction methods and elements.
  - Utility relocations are possible, but are not likely to be as extensive as for other alternatives.
- Seawall Retrofit Option B1 – Face Wall Only. The face wall only seawall retrofit option (with construction inboard of the existing wharf wall) was not recommended to be carried forward to the EIS for the following reasons:
  - In order to meet current seismic design standards, as required by mandatory screening criteria Goal 1 (see Paragraph 3.2.a above), seawall alternative options must be able to improve the ability of the Seawall to respond to both vertical and lateral loads. The face wall only alternative is designed to only carry the lateral earth pressure loads.
- Seawall Retrofit Option B2 – Anchored Wall. The anchored wall seawall retrofit option was not recommended to be carried forward to the EIS for the following reasons:

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<sup>4</sup> Ibid.

- In order to meet current seismic design standards, as required by mandatory screening criteria Goal 1 (see Paragraph 3.2.a above), seawall alternative options must be able to improve the ability of the Seawall to respond to both vertical and lateral loads. The anchored wall alternative is designed to only carry the lateral earth pressure loads.
- Seawall Retrofit Option B3 – Buttress Fill. The buttress fill seawall retrofit option was not recommended to be carried forward to the EIS for the following reasons:
  - In order to meet current seismic design standards, as required by mandatory screening criteria Goal 1 (see Paragraph 3.2.a above), seawall alternative options must be able to improve the ability of the Seawall to respond to both vertical and lateral loads. The buttress fill alternative is designed to only carry the lateral earth pressure loads.

**4. DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE SR 99 ALASKAN WAY VIADUCT AND SEAWALL REPLACEMENT PROJECT.** Six alternatives to improve the existing SR 99 corridor now served by the Alaskan Way Viaduct were analyzed in the March 2004 draft Environmental Impact Statement (EIS). They include one no-action alternative titled No Build, and five build alternatives: Rebuild, Aerial, Tunnel, Bypass Tunnel, and Surface. The five build alternative would rebuild or replace the existing Alaskan Way Viaduct and the Alaskan Way Seawall. Each alternative is named according to the type of roadway proposed through the central section of the project area. The stated purpose of the proposed action is to provide a transportation facility and seawall with improved earthquake resistance that maintains or improves mobility and accessibility for people and goods along the existing Alaskan Way Viaduct Corridor.

Due to the inclusion of the Tunnel and Bypass Tunnel build alternatives for replacement of the Alaskan Way Viaduct, the relationship of Seawall alternatives to the Alaskan Way Viaduct were paired up as follows:

<u>Viaduct Alternative</u>	<u>Seawall Options</u>
Rebuild	Rebuild seawall (Replacement Option A4 – strengthen soils and add drilled shafts behind the existing seawall)
Aerial	Rebuild seawall (Option A4) or replacement Option A3 – Vertical Face Wall with Structural Frame)
Tunnel	Replace seawall with outer wall of tunnel in central section, and rebuild seawall north and south of tunnel (Option A4)
Bypass Tunnel	Tunnel Wall in central section, and rebuild seawall north and south of tunnel (Option A4)
Surface	Rebuild seawall (Option A4)

**5. PROBLEMS AND OPPORTUNITIES, AND PLANNING OBJECTIVES AND CONSTRAINTS FOR ALASKAN WAY SEAWALL FEASIBILITY STUDY.** A number of problems and opportunities, as well as planning objectives and constraints, have been identified for the feasibility study. These will be continuously reviewed and revised throughout the planning process. Ultimately, alternative plans will be screened against planning objectives and constraints in selecting an alternative plan to be recommended for adoption and implementation.

**5.1 Problems and Opportunities.**

- The Alaskan Way Seawall is experiencing significant decay and deterioration, leading to structural instability along the Seattle waterfront and central business district.
- Seawall structural instability is putting a tremendous amount of public and private infrastructure, development, and transportation linkages at risk of damage and loss.
- Failure of the Seawall will result in a high risk to public safety.
- Failure of the Seawall has the high probability of resulting in significant environmental damage.
- The 70-year old Seawall is at the end of its physical life, and must be rehabilitated before extensive public infrastructure and private development is damaged and lost due to storm wave and tidal action subsequent to failure of the Seawall.
- Rehabilitation of the Seawall with a structure that meets seismic standards will provide long-term and effective protection to public facilities and economic activities along the Seattle waterfront.

**5.2 Planning Objectives.** The following are planning objectives that have thus far been identified for the seawall project:

- Ensure that all alternative plans provide facilities that meet current seismic standards.
- Maintain effective shoreline protection to the City of Seattle waterfront from coastal storms.
- Maintain and protect transportation functions and linkages, including Alaskan Way and the Alaskan Way Viaduct Corridor.
- Safeguard public utilities located under Alaskan Way and on the Alaskan Way Viaduct, including regional power grid lines and utilities serving the city center (including electricity, natural gas, steam heat, water, sewer, and telecommunications lines).
- Ensure access to waterfront public facilities, including Washington State ferry terminal, Seattle fire station and fire boats, Seattle Aquarium, Port of Seattle cruise terminal and convention center, and recreational uses and commercial development along the waterfront.
- Adhere to the Corps' Environmental Operating Principles; consider conservation, environmental preservation and ecosystem restoration in the formulation of alternative plans.

- Ensure that shoreline protection is in consonance with the City of Seattle waterfront planning process, and supports land use and shoreline plans and policies pertaining to the downtown Seattle waterfront.
- Support bicycle and pedestrian accessibility and mobility.
- Minimize adverse social, cultural, recreational, environmental and economic impacts during and after construction.
- Minimize impacts to utility corridors during and after construction.
- Support land use and shoreline plans and policies pertaining to existing and future development of the downtown Seattle waterfront.
- Support improved habitat for fish and wildlife along the seawall.

**5.3 Planning Constraints.** The following planning constraints have been thus far been identified:

- Transportation functions of the Alaskan Way Viaduct surface transportation corridor must be maintained.
- Construction must minimize adverse impacts to existing economic activity and transportation modes in the project area.
- The selected alternative must rely on proven construction methods, minimize construction duration, and promote effective traffic management during construction.

**6. CORPS OF ENGINEERS GAP ANALYSIS REPORT.** As noted in Paragraph 2 above, the Corps had a review conducted of the March 2004 Alaskan Way Viaduct and Seawall Replacement Project draft EIS and supporting technical documents, to identify “gaps” – or potential areas for additional study – that may be needed to support the Corps’ environmental analysis under the National Environmental Policy Act (NEPA). The report, dated September 2005 and entitled *Gap Analysis for Elliott Bay Seawall Feasibility Study: Seattle, Washington*, was prepared for the Corps by Jones & Stokes. Conclusions from the gap analysis report which are relevant specifically to the range of alternative plans to be evaluated in the Seawall feasibility study and EIS include the following.

- Extensive outreach has already been conducted, though most comments appear to address the Alaskan Way Viaduct alternatives. The Alaskan Way Seawall environmental review process can benefit from the extensive outreach previously conducted, and its future public participation efforts can be more focused specifically on the Seawall.
- Alternatives and design options are clearly described in previous documents; however, the alternatives for seawall rebuild and retrofit – and the specific sub-options for each – did not include all alternatives that may be considered by the Corps.

- Alternatives to be evaluated as part of the Seawall-focused feasibility study will be fully described in the EIS. Where appropriate, cross references to alternatives described in previous will be provided, including references to titles of alternatives that may have changed since documents were written.

## **7. MANAGEMENT MEASURES PROPOSED TO BE FURTHER EVALUATED.**

A number of management measures are proposed for further evaluation by the Corps of Engineers and the City of Seattle in the feasibility study and EIS. The feasibility study is seawall-focused, and care has been taken to ensure that no technically feasible alternative is prematurely screened out. The screening criteria developed by the City of Seattle (see Paragraph 3.2 above), and their application to the screening of seawall concepts, has been reviewed by Corps of Engineers staff and found to be valid and legitimate. Because planning is an iterative process, screening criteria will be continuously reviewed and modified as necessary as the final array of alternative plans is developed and evaluated.

The final array of alternative plans developed for the feasibility study is likely to include plans that consist of combinations of measures functioning together to address one or more planning objectives and the different segments and functions of the seawall. For example, if a plan is implemented by the Federal Highway Administration to replace the existing Alaskan Way Viaduct with a tunnel, a seawall alternative plan will necessarily include replacement of a significant portion of the existing seawall with the outer State Route 99 tunnel wall; the seawall alternative plan for seawall segments to the north and south of the tunnel might consist of a combination of different measures. Similarly, if the viaduct replacement is by means other than a tunnel, the selected alternative plan for the entire seawall will be a combination of measures. In all cases, actual seawall design, features and precise construction techniques have not yet been determined.

The Alaskan Way Seawall feasibility study is being evaluated by the Corps of Engineers as a major rehabilitation project. Rehabilitation of the aging seawall is thus guiding the identification of management measures and the formulation of alternative plans to determine which rehabilitation strategy is best to ensure the long term reliability of a seawall to serve its intended functions. The existing seawall serves a variety of critical functions that will continue into the foreseeable future. Thus, the overall goal of the feasibility study is to formulate a full array of alternative plans to deal with seawall reliability problems and take advantage of improvement opportunities. Ongoing engineering analysis will address seawall reliability problems, providing a basis for decisions on how best to replace each segment of the seawall. Meeting applicable seismic design standards is a key component of the engineering analysis. Improvement opportunities – including such things as efficiency, fish and wildlife habitat, recreation, public access, and aesthetics – will be addressed during the formulation and design of alternative plans.

Management measures are the building blocks of alternative plans and are categorized as either structural or non-structural. Generally, equal consideration is given by the Corps to these two categories of measures during the plan formulation process. An alternative plan is a set of one or more management measures functioning together as a means of addressing identified

problems and opportunities and of satisfying one or more planning objectives. Non-structural measures may be combined with structural measures to produce an alternative plan, or considered as an alternative to structural measures.

For a coastal storm damage reduction project, property acquisition is a typical non-structural measure considered during the planning process. This measure would entail the acquisition of property and the permanent removal of all infrastructure and development so as to preclude damage in the absence of effective seawall function. The Alaskan Way Seawall is a major rehabilitation project, and such a non-structural alternative would not address any identified problem or opportunity, nor would it address any stated planning objective. As an alternative to structural measures, property acquisition and removal of all public infrastructure and private development supported by the fill behind the Alaskan Way Seawall is not believed to be either a feasible or acceptable management measure for this major rehabilitation project affecting the Seattle downtown waterfront.

A number of alternative measures are recommended to be carried forward for further evaluation in the feasibility study and EIS. They do not represent the final array of alternative plans. Nor do they convey design features of the seawall or specific construction techniques that would be used to replace specific segments of the existing seawall. What they represent, however, are simply the technically viable alternatives – plus the no action alternative – that evolved from prior screening documented above. The alternatives are likely to be modified and/or combined with other measures to form distinct alternatives in the final array of alternative plans. Because significant environmental evaluation or public outreach on seawall-specific alternatives has not been completed, it is appropriate to continue to refine alternative measures, and to consider opportunities for combining measures based on site-specific assessments of technical feasibility, environmental acceptability, cost, public acceptance, and opportunities to enhance or restore habitat values for fish and wildlife, and recreational opportunities and public access along the Seattle waterfront. The following four alternatives – including the No Action plan by which all other alternative plans will be compared – are recommended by the Corps of Engineers and City of Seattle to be carried forward for further evaluation as part of the Alaskan Way Seawall feasibility study and EIS:

- No Action
- Vertical Face Wall with Structural Frame. This is seawall rebuild Option A3 previously considered by the City of Seattle.
- Drilled Shaft Wall with Soil Improvement. This is seawall rebuild Option A4 previously considered by the City of Seattle.
- Tunnel Wall (applicable to the State Route 99 Tunnel and Bypass Tunnel transportation alternatives).

It is important to note that the final array of alternative plans, from which a recommended plan will be selected, will include many general and site-specific construction and operational features and attributes for different segments of the seawall. Alternative plans, therefore, will

likely consist of varying combinations of measures. Each alternative plan will also incorporate habitat enhancements, recreational features, and visual attributes, as well as possible deviations from the alignment of the existing seawall. Such project features and attributes will be in response to such items as transportation, visual quality, noise and vibration, land use and shorelines, parks and recreation, social resources, environmental justice, relocations, historic resources, archeological resources and traditional cultural places, public services and utilities, economics, air quality, fisheries, wildlife and habitat, water resources, geology and soils, hazardous materials, and energy.

2 enclosures